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PATTERNS OF NONBREEDING SNOWY PLOVER (*Charadrius alexandrinus*), PIPING PLOVER (*C. melodus*), AND RED KNOT (*Calidris canutus*) DISTRIBUTION IN NORTHWEST FLORIDA

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Abstract.—From August 2006 to May 2007 observers from Apalachicola Riverkeeper conducted one to four counts of nonbreeding shorebirds per month at nine northwest Florida migratory bird sites across 59 km of mainland and barrier island coastline in Franklin and Wakulla counties. We calculated nonbreeding seasonal abundance at each site for three migratory bird species of conservation concern in Florida: Snowy Plover (*Charadrius alexandrinus*), Piping Plover (*C. melodus*) and Red Knot (*Calidris canutus*). For these three highly vulnerable shorebird species we recorded habitat use and movements of individually color-banded birds. Additionally, we offer recommendations to reduce anthropogenic disturbances to nonbreeding shorebirds in northwest Florida.

Shorebirds are a large and diverse group of migratory waterbirds that includes plovers, oystercatchers, stilts, avocets, and sandpipers. Most shorebird species breed inland at high latitudes yet spend much of their annual life cycles in lower-latitude coastal regions. Only six shorebird species breed in Florida, yet many shorebird species spend 10 or more consecutive non-summer months per year in the state (Robertson and Woolfenden 1992, Stevenson and Anderson 1994).

Across North America populations of many shorebird species have declined because of historical overharvesting and continued habitat degradation and loss (Brown et al. 2001). In Florida, shorebirds are a group of high-priority wildlife species identified as being in need of basic survey and monitoring (Millsap et al. 1990). Several Florida shorebird species are already on either the federal or state imperiled species lists. Snowy Plover (*Charadrius alexandrinus*) is designated by the state of Florida as a Threatened species (Florida Administrative Code 68A-27.004); Snowy Plover is also considered an at-risk species at the

federal level. Piping Plover (*C. melodus*) is protected as a Threatened species under the U.S. Endangered Species Act (ESA), and the Great Lakes Piping Plover breeding population is classified as Endangered (USFWS 1985). Piping Plover is also on the Florida state list as a threatened species (FAC 68A-27.004). Red Knot (*Calidris canutus*) was designated as a candidate species for federal listing under the ESA in 2006 (USFWS 2006).

The amount and quality of Florida's coastal waterbird habitat has declined (Johnson and Barbour 1990, Kautz 1993) and much remains to be learned of nonbreeding shorebird distribution in many coastal areas, especially along Florida's northern Gulf coast. In northwest Florida, quantitative nonbreeding shorebird information is limited and few waterbird surveys have included multiple nonbreeding shorebird species (Gunnels 1999, Sprandel et al. 2000, Sprandel 2007); fewer still have focused on nonbreeding shorebirds in seasons other than winter (Sprandel 2007). International Piping Plover and Snowy Plover (and Red Knot in Florida) Census results from 2001 and 2006 revealed winter (January) concentrations of these three high priority migratory bird species in the eastern Florida panhandle region, particularly in Franklin and Wakulla counties (USFWS unpubl. data). Apalachicola Riverkeeper personnel and volunteers sought to gather information on nonbreeding seasonal distribution and relative abundance of these three species in this area that had been surveyed infrequently in the past and where consistent replicated shorebird counts have been conducted at only a few sites (Sprandel 2007). We also identified anthropogenic disturbance of nonbreeding shorebirds (i.e., disturbance directly by humans or indirectly attributable to them, such as by house pets), and recommend ways of reducing it to improve shorebird survival.

METHODS

One observer, with the help of one to three volunteers, conducted 173 counts of 25 nonbreeding shorebird species on foot or with low-tire-pressure all-terrain vehicles (ATVs) one to four times per month ($\bar{x} = 1.9$ counts per site per month) at nine migratory bird sites across 59.4 km of mainland and barrier island coastline in Franklin and Wakulla counties from 15 August 2006-8 May 2007. Migratory shorebird sites surveyed included coastal and island sites on both publicly and privately owned lands: St. Vincent National Wildlife Refuge (federal), two Florida State Parks (state), two municipal parks (county), two Nature Conservancy (TNC) closed preserves (private), an unmanaged private site Yent Bayou, and Lanark Reef, an important offshore migratory bird site that is predominately sovereign submerged state lands (Fig. 1). These migratory shorebird survey sites were not uniform in size (1.1-20 km) or composition (Table 1). Survey sites contained varying proportions of high-energy Gulf beaches (0-14 km), low-energy sound beaches (0.2-7 km), and other wildlife habitats such as salt marshes, tidal creeks, and oyster bars. One important Franklin County migratory bird site, Cape St. George State Reserve, a portion of which is part of wintering Piping Plover Critical Habitat unit FL-8 (USFWS 2001), was not surveyed due to logistical difficulties in accessing this island site.

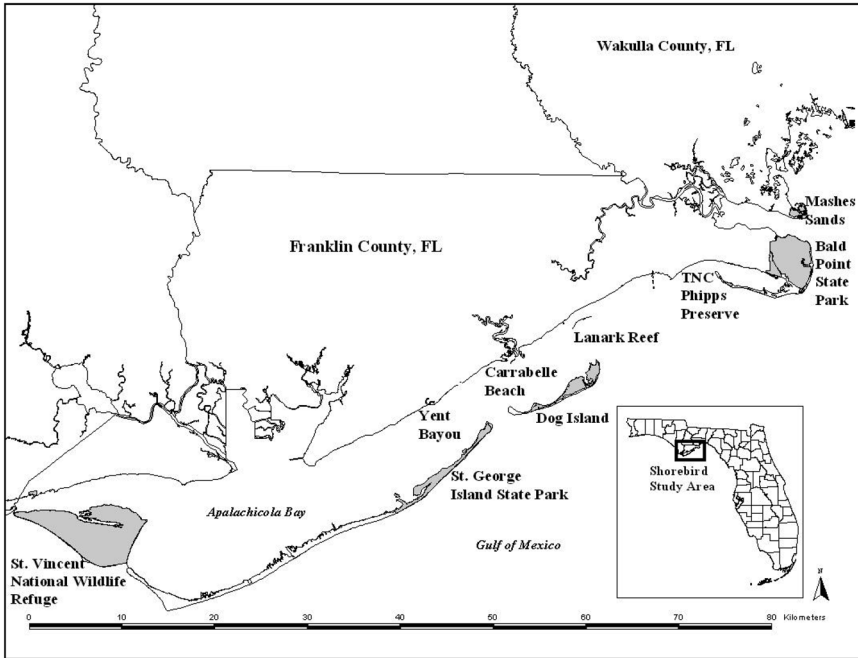


Figure 1. Northwest Florida nonbreeding shorebird study area.

During each visit we recorded the general weather, wind speed on the Beaufort scale, temperature, tidal stage (low, mid, or high) and tide direction (rising or falling). We also collected information on human use of migratory bird sites and information on shorebird disturbance factors: the number of people and dogs observed, number of vessels landing or passing within 50 m of shore, presence or absence of vehicles or ATVs and vehicle or ATV tracks, and presence or absence of dog or raccoon tracks. On initial site visits, we recorded habitat information on the area immediately landward of each survey area and the number of human access points.

We made all nonbreeding shorebird observations with a 40-60x spotting scope and binoculars. During each visit, the numbers of individuals of all shorebird species were counted, and then band combinations were recorded on banded birds. We searched the upper, mid- and lower beaches, as well as sand and mud flats and offshore shoals for roosting or foraging shorebirds. All nonbreeding shorebird counts were conducted in fair weather during daylight hours only, and lasted ≥ 30 min, even if few birds were present.

Few large groups of shorebirds (>500 individuals) were encountered at each site, and therefore we recorded complete counts, and not estimations, by species. Counts were summarized as seasonal shorebird abundance per site (autumn: August–November 2006, winter: December 2006–February 2007, and spring: March–May 2007). At any given site, shorebird numbers vary by day, season, and year. As such, data presented here should be considered minimum estimates of seasonal abundance. (Note: this nonbreeding shorebird survey began in mid-August 2006 and may have missed the beginning of the autumn migration period. Future nonbreeding shorebird surveys should begin in early- to mid-July and continue at least until the beginning of June in order to encompass the entire nonbreeding shorebird season in northwest Florida.)

Table 1. Northwest Florida shorebird study sites.

Shorebird Study Site	Total Area (ha)	Mean Survey Effort (hr)	Total Distance Gulf Shoreline (km)	Bay or Sound Shoreline (km)	Surveyed (km)	Wintering Piping Plover Critical Habitat Unit
St. Vincent NWR	5054	5.7	13.0	7.0	FL-8	
St. George Island SP	818	5.8	14.0	3.0	FL-9	
Yent Bayou	39	1.2	0.0	1.8	FL-10	
Carrabelle Beach	84	3.1	0.0	3.0	FL-11	
Dog Island-east end	446	3.9	4.0	2.0	—	
Lanark Reef	264	3.7	1.6	1.6	FL-12	
TNC Phipps Preserve	16	4.5	3.2	3.2	FL-13	
Bald Point State Park	1966	1.9	2.3	0.2	—	
Mashes Sands Park	195	1.8	0.8	0.3	—	

Observations of Snowy and Piping Plovers and Red Knot and all individually marked birds were geo-located with a handheld Global Positioning System receiver. Movements could be determined by repeated observations of individually color-banded birds, and we documented behavior (roosting or foraging), habitat use, and relative abundance by site of these three shorebird species of conservation concern thought to be declining in Florida.

RESULTS

From August 2006-May 2007, we located Snowy Plovers at seven of nine migratory bird sites surveyed (Table 2a). Two large barrier islands: St. George Island State Park and St. Vincent National Wildlife Refuge, along with TNC Phipps Preserve, hosted more nonbreeding Snowy Plovers than the other four sites. We located Piping Plovers at eight of nine sites (Table 2b), and TNC Phipps Preserve contained the highest numbers of Piping Plovers in all three seasons. Red Knots were most numerous at St. Vincent National Wildlife Refuge in winter and spring, and at Carrabelle Beach in autumn, but were located at all nine sites in at least one season (Table 2c).

All three species were present in northwest Florida in all ten months and in all three seasons, yet Piping Plover and Red Knot were less numerous in winter than during spring or fall migrations (Tables 2b-2c). Snowy Plover numbers were more stable among seasons and were lower in spring than in winter and fall at these sites (Table 2a). It

Table 2a. Snowy Plover (*Charadrius alexandrinus*) seasonal count ranges and means \pm standard deviation (SD) per site from 15 August 2006-8 May 2007.

Site:	Autumn August-November		Winter December-February		Spring March-May	
	Range	Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD
SVNWR	7-15	11.8 \pm 3.6	11-25	15.3 \pm 4.5	14-19	17.3 \pm 2.8
SGISP	5-28	16.6 \pm 6.5	6-26	14.1 \pm 8.6	4-19	11.8 \pm 6.7
YB	0	0	0-2	0.6 \pm 1.0	0	0
CB	0-10	2.5 \pm 3.5	0-3	1.3 \pm 1.2	0	0
DI	0-8	3.3 \pm 2.4	0-13	3.8 \pm 5.4	2-5	3.5 \pm 1.3
Lanark	0-8	1.7 \pm 2.5	0-1	0.1 \pm 0.4	0-1	0.3 \pm 0.5
Phipps	1-25	7.3 \pm 6.7	2-10	5.6 \pm 2.7	1-8	5.0 \pm 3.1
BPSP	0	0	0	0	0	0
MS	0	0	0	0	0	0
Total		43.2		40.8		37.9

SVNWR = St. Vincent National Wildlife Refuge, SGISP = St. George Island State Park, YB = Yent Bayou, CB = Carrabelle Beach, Lanark = Lanark Reef west of pelican rookery, DI = TNC Jeff Lewis Wilderness Preserve on Dog Island-east end, Phipps = TNC John S. Phipps Preserve/Alligator Point Critical Wildlife Area, BPSP = Bald Point State Park-North Point beach access, MS = Mashas Sands Park (owned by the State of Florida and managed as a Wakulla County park).

Table 2b. Piping Plover (*Charadrius melodus*) seasonal count ranges and means \pm standard deviation (SD) per site from 15 August 2006-8 May 2007.

Site:	Autumn August-November		Winter December-February		Spring March-May	
	Range	Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD
SVNWR	0-1	0.5 \pm 0.6	1-2	1.6 \pm 0.6	1-5	3.0 \pm 2.0
SGISP	4-24	12.2 \pm 4.7	5-11	8.8 \pm 3.3	5-9	7.6 \pm 1.7
YB	0-2	0.3 \pm 0.8	0-2	0.5 \pm 0.8	0	0
CB	0-4	1.7 \pm 1.4	0-2	1.1 \pm 1.0	0-1	0.4 \pm 0.5
DI	1-14	6.5 \pm 5.2	0-13	4.4 \pm 5.3	0-8	3.8 \pm 3.9
Lanark	5-29	13.9 \pm 7.0	4-20	8.3 \pm 6.3	0-21	8.5 \pm 9.1
Phipps	16-47	26.3 \pm 9.2	0-24	13.5 \pm 10.1	12-47	27.6 \pm 15.4
BPSP	0-3	1.2 \pm 1.0	0-3	1.6 \pm 1.5	0-4	1.4 \pm 1.7
MS	0	0	0	0	0	0
Total		62.6		39.8		52.3

SVNWR = St. Vincent National Wildlife Refuge, SGISP = St. George Island State Park, YB = Yent Bayou, CB = Carrabelle Beach, Lanark = Lanark Reef west of pelican rookery, DI = TNC Jeff Lewis Wilderness Preserve on Dog Island-east end, Phipps = TNC John S. Phipps Preserve/Alligator Point Critical Wildlife Area, BPSP = Bald Point State Park-North Point beach access, MS = Mashers Sands Park (owned by the State of Florida and managed as a Wakulla County park).

Table 2c. Red Knot (*Calidris canutus*) seasonal count ranges and means \pm standard deviation (SD) per site from 15 August 2006-8 May 2007.

Site	Autumn August-November		Winter December-February		Spring March-May	
	Range	Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD
SVNWR	3-25	12.8 \pm 9.7	5-61	33.0 \pm 28.0	19-345	170.0 \pm 164.3
SGISP	0-20	2.5 \pm 5.9	0-19	10.1 \pm 8.0	8-17	12.4 \pm 3.6
YB	0	0	0	0	0-1	0.2 \pm 0.4
CB	0-139	43.1 \pm 47.9	0-6	2.5 \pm 2.4	3-44	21.4 \pm 17.5
DI	0-57	15.1 \pm 19.5	0-71	14.4 \pm 31.6	20-94	55.8 \pm 38.2
Lanark	0-106	11.7 \pm 27.9	0-113	19.5 \pm 5.2	0-77	20.8 \pm 37.5
Phipps	0-23	7.5 \pm 6.9	0-13	4.1 \pm 4.8	2-57	20.8 \pm 21.6
BPSP	0-3	0.5 \pm 1.2	0	0	0-10	3.4 \pm 3.9
MS	0	0	0	0	0-16	6.0 \pm 7.4
Total		93.2		83.6		310.8

SVNWR = St. Vincent National Wildlife Refuge, SGISP = St. George Island State Park, YB = Yent Bayou, CB = Carrabelle Beach, Lanark = Lanark Reef west of pelican rookery, DI = TNC Jeff Lewis Wilderness Preserve on Dog Island-east end, Phipps = TNC John S. Phipps Preserve/Alligator Point Critical Wildlife Area, BPSP = Bald Point State Park-North Point beach access, MS = Mashers Sands Park (owned by the State of Florida and managed as a Wakulla County park).

is important to note that unlike Piping Plover and Red Knot, Snowy Plover breeds annually in northwest Florida, from February-August, and low densities of this species in spring may indicate a seasonal re-

distribution from higher-density wintering sites to territories at other Florida breeding locations.

Snowy Plovers both overwinter and migrate through northwest Florida seasonally, but the only two individually marked Snowy Plovers observed in this study were banded as adults in northwest Florida (Bay and Gulf counties) in 2004 (FFWCC [Florida Fish and Wildlife Conservation Commission] unpubl. data). The number of resightings of the two color-banded Snowy Plovers was low, and color-banded birds were observed only three times from October to November, and four times from August to February, respectively, at St. George Island State Park.

We documented 31 banded Piping Plovers at six of our study sites. Birds were banded by various researchers from 2002 to 2006 using unique combinations of colored leg bands, U.S. Fish and Wildlife Service metal bands, and flags (bands with tabs that extend away from the leg) indicating geographic origin by color at seven breeding sites in the Great Lakes and Great Plains areas in three American states and one Canadian province. The number of banded nonbreeding Piping Plover resightings in northwest Florida from August-May was high (≤ 15 , mean = 7.3), yet only three of 31 Piping Plovers were documented using more than one site in our study area. Plovers used both Lanark Reef and Dog Island (separated by a distance of 5 km), and Carrabelle Beach and Dog Island (separated by a distance of 9 km). Eighteen of 31 banded Piping Plovers (58%) observed in northwest Florida from August 2006 to May 2007 were from the Great Lakes watershed (endangered breeding population) in Michigan and Wisconsin. We located Piping Plovers from the Great Lakes watershed at St. Vincent National Wildlife Refuge, St. George Island State Park, Carrabelle Beach, Dog Island, and TNC Phipps Preserve. The geographic origin of several banded Piping Plovers observed in northwest Florida could not be determined.

Six of 31 nonbreeding Piping Plovers observed in northwest Florida in 2006 and 2007 were banded along the Missouri River (green flags) at one site near Ponca, Nebraska and two sites near Vermillion and Yankton, South Dakota (D. Catlin in litt.). Five of 31 Piping Plovers observed in northwest Florida were banded at two breeding sites in Saskatchewan, Canada (black or white flags): Big Quill Lake and Lake Diefenbaker (S. Westworth, C. Gratto-Trevor in litt.). We also observed Piping Plovers in northwest Florida that were banded on Lake Michigan in Sleeping Bear Dunes National Lakeshore, Ludington, Sturgeon Bay, Port Inland, Cross Village, and Wilderness State Park, on Lake Huron in Alpena, Michigan, and on Lake Superior in Apostle Islands National Lakeshore in Wisconsin. One Piping Plover that was captive reared at the University of Michigan Biological Station in Pell-

ston, Michigan in 2006 (O. LeDee in litt.) was noted 11 times at TNC Jeff Lewis Wilderness Preserve on Dog Island from August 2006-April 2007.

We documented 28 banded Red Knots at seven northwest Florida migratory bird sites in 2006 and 2007. Red Knots were banded from 2002-2007 using unique combinations of U.S. Fish and Wildlife Service metal bands, colored leg bands, and green flags with or without three black characters (capital letters and/or numbers) at seven nonbreeding sites in three states: four sites in New Jersey, two sites in Florida, and one site in Delaware. Nine of 28 Red Knots observed in northwest Florida were banded in winter in southwest Florida: eight were banded on Sanibel Island (Lee County) in January 2007 and one was banded on Longboat Key in December 2005. Seven of 28 Red Knots observed in northwest Florida were banded in August 2005 on the Atlantic coast at Stone Harbor in New Jersey. Two of 28 banded knots observed in northwest Florida were banded on Delaware Bay at Fortescue, New Jersey, in May 2004 and May 2005. One was banded at the North Brigantine Natural Area, New Jersey, in October 2006, and two were banded at Avalon, New Jersey, in November 2005. We also observed Red Knots in northwest Florida that were banded at an unknown location in Delaware in 2002, an unknown location in New Jersey in 2005, and one unknown location in Florida in 2007 (W. Pitts in litt.). Nine Red Knots banded in southwest Florida in winter 2007 were observed in northwest Florida in spring 2007: one in March, seven in April, and one in May.

Three banded Red Knots located in northwest Florida in autumn were banded in New Jersey in 2005. One Red Knot banded in 2002 (dark green flag without characters) in Delaware was observed in November 2006 and March 2007 at St. Vincent National Wildlife Refuge. Birds observed in northwest Florida in winter (4) were banded in New Jersey in 2005 and 2006. Red Knots observed in spring in northwest Florida were banded in New Jersey (7) or southwest Florida (9). Although only a small proportion of Red Knots observed in northwest Florida (Table 2c) were banded, and resightings of individually marked birds were low (≤ 3), we did document Red Knots moving among northwest Florida migratory bird sites. Four of 28 banded Red Knots were observed utilizing >1 site in spring (April): Dog Island and Lanark Reef, and Bald Point State Park and Dog Island, distances of 5 km and 23 km, respectively. One Red Knot banded at Stone Harbor in New Jersey in August 2005, was noted using two sites, once in January and April 2007, St. George Island State Park and Lanark Reef, a linear distance of 27 km. Color-banded Piping Plovers that were not observed in winter (7 of 31 or 22.5%) seemed to utilize the same sites in both autumn (2006) and spring (2007). TNC Phipps Preserve/Alligator Point

Critical Wildlife Area had the highest number of Piping Plovers (47), in both fall 2006 and spring 2007, and the most banded Piping Plovers (14) noted at one time. In 2006 and 2007, St. Vincent National Wildlife Refuge had the highest number of Red Knots (345) and the most banded Red Knots recorded at one time (8), in spring 2007, yet a maximum of only five Piping Plovers was observed at this site.

DISCUSSION

Although the number of banded birds observed in this one non-breeding season is small relative to current Gulf coast winter population estimates (Harrington et al. 1988, Nicholls and Baldassarre 1990), we suggest that Piping Plover may be less mobile among these non-breeding sites than Red Knot in both winter and in migration and that both species overwinter in as well as migrate through northwest Florida's Gulf coast wildlife habitats in autumn and spring. Further, a complex of multiple well-managed migratory bird sites established within close range of one another may be even more important to recovery of more mobile shorebird species such as Red Knot.

It is clear that some Red Knots banded in winter on the Gulf coast of southwest Florida migrate through northwest Florida's Gulf coast in spring. It is also important to understand that distant migratory bird sites in Florida are linked and to recover declining migratory bird species statewide, identification of and sound management of multiple sites is critical. This would include northwest Florida sites with relatively small wintering shorebird numbers (but a large number of winter shorebird species) that are important to multiple declining shorebird species such as Lanark Reef, TNC Phipps Preserve, and St. Vincent National Wildlife Refuge. Initial Piping Plover conservation efforts have focused on increasing reproductive success on northern breeding grounds, yet many anthropogenic factors during nonbreeding seasons may negatively impact annual shorebird survivability (Brown et al. 2001, USFWS 2003).

Franklin County, Florida, has several sites that are important to declining shorebird species. For example, the U.S. Fish and Wildlife Service has designated six of our nine study sites (Table 1) as wintering Piping Plover Critical Habitat units (USFWS 2001). Six of our study sites are publicly owned and managed, however, three of our study sites remain unmanaged, and shorebird conservation often is far from the highest management priority even at many managed sites. Wildlife conservation is also often not buttressed by adequate educational and law enforcement programs.

Five of our northwest Florida study sites are posted seasonally each year to prevent trespass during the spring and summer shorebird

and seabird breeding season. Migration and harsh weather impose high energy costs on shorebirds, so it is especially important to reduce disturbance, especially from house pets, at foraging and roosting sites during the nonbreeding period (Burger and Gochfeld 1991, Thomas et al. 2003). Efforts should be made to reduce anthropogenic disturbances to nonbreeding shorebirds and their habitats, particularly state and/or federally listed shorebird species such as Snowy and Piping Plovers, and Red Knot (Brown et al. 2001, Lafferty 2001).

For example, Sprandel (2007) noted consistent usage of the unmanaged site Carrabelle Beach by migratory shorebirds from 1994-2005. In 2006 and 2007, we also recorded usage by large numbers of shorebirds at this site and noted relatively large numbers of species of conservation concern such as Red Knot (Table 2c). We also routinely observed humans and unleashed domestic dogs flushing federally and state listed species such as Snowy and Piping Plovers, American Oystercatcher (*Haematopus palliatus*), and Red Knot, despite a county ordinance requiring domestic dogs to be on a leash at all times. Lafferty (2001) found that symbolic fencing (i.e., a series of posts or stakes, which may be connected by cord or tape) and signs were successful in providing refuge from anthropogenic disturbance (including house pets) for wintering western Snowy Plovers while still allowing for lawful human of the beach.

Nicholls and Baldasarre (1990) found that (Piping) plover wintering sites had an average of 0.7 people/km and that non-(Piping) plover sites had an average of 6.5 people/km. Smith (2007) found that Carrabelle Beach, a site with a small number of wintering Piping Plovers (Table 2b) had a winter recreational activity rate of 4.6 people/km in 2006 and 2007, yet the overall (fall-spring) rate was 8.3 people/km and the spring (March-May) recreational activity rate was 15.9 people/km. Snowy and Piping Plovers and Red Knot were least abundant at this site in spring (Table 2a-c). Additionally, as more Piping Plovers and Red Knots (Table 2b-c) were observed at this site in autumn than in winter 2006 and 2007, nonbreeding shorebird protection efforts that focus on migration as well as winter would benefit a greater number of birds. Informational signage and symbolic fencing, at least on some portion of this unmanaged migratory bird site may help to lessen anthropogenic disturbances during the shorebird nonbreeding season, perhaps most especially from housepets.

Two important migratory bird sites in Franklin County could benefit from increased management attention and/or from development of wildlife conservation plans. Lanark Reef, noted by Sprandel et al. (2000) as one of the most important winter shorebird sites in Florida, had the highest number of shorebird species present in fall and winter in our 2006-2007 survey. Yet, Smith (2007) noted people

or human footprints on 8 of 24 visits (33%), and domestic dogs or dog tracks on 5 of 24 visits (21%) in 2006 and 2007 at this offshore migratory bird site that had historically benefited from the lack of human recreational pressures and mammalian predators (Gunnels 1999, FFWCC unpubl. data). Furthermore, this site which is largely publicly owned submerged land, is managed only minimally and is a good candidate for state Critical Wildlife Area designation. This would allow for all available law enforcement personnel to actively prevent trespass and to prohibit unauthorized vessel landings. The Nature Conservancy Jeff Lewis Wilderness Preserve on Dog Island would also benefit from establishment as a Critical Wildlife Area.

Fortunately, actions taken by public land managers to aid Piping Plover and Red Knot recovery also benefit other shorebird and seabird species, many of which are also declining (USFWS 2008). There remains, however, a real need to inform local decision makers of the importance of Franklin County's fish and wildlife habitats to international migratory bird conservation. Further, as the population in this formerly rural area increases, the quality of these wildlife habitats may be lessened by local land use changes and increases in pressure from human recreation, unless they are actively managed for migratory bird conservation. Beneficial management actions include (1) posting informational signage regarding minimization of disturbance to roosting or foraging shorebirds, (2) erecting symbolic fencing to guide visitors away from shorebird concentrations, (3) enforcing existing pet leash laws, (4) use of predator proof refuse containers to avoid concentrating predators such as feral cats, (5) limiting and/or regulating vehicles on the beach, and (6) educating local residents and visitors about migratory bird conservation.

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